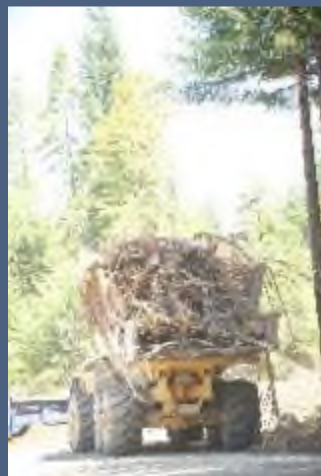
California Biopower Impacts Project

California Bioresources Economy Summit
January 29th, 2019

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Schatz Energy Research Center

HUMBOLDT STATE UNIVERSITY

STATE OF CALIFORNIA ENERGY COMMISSION

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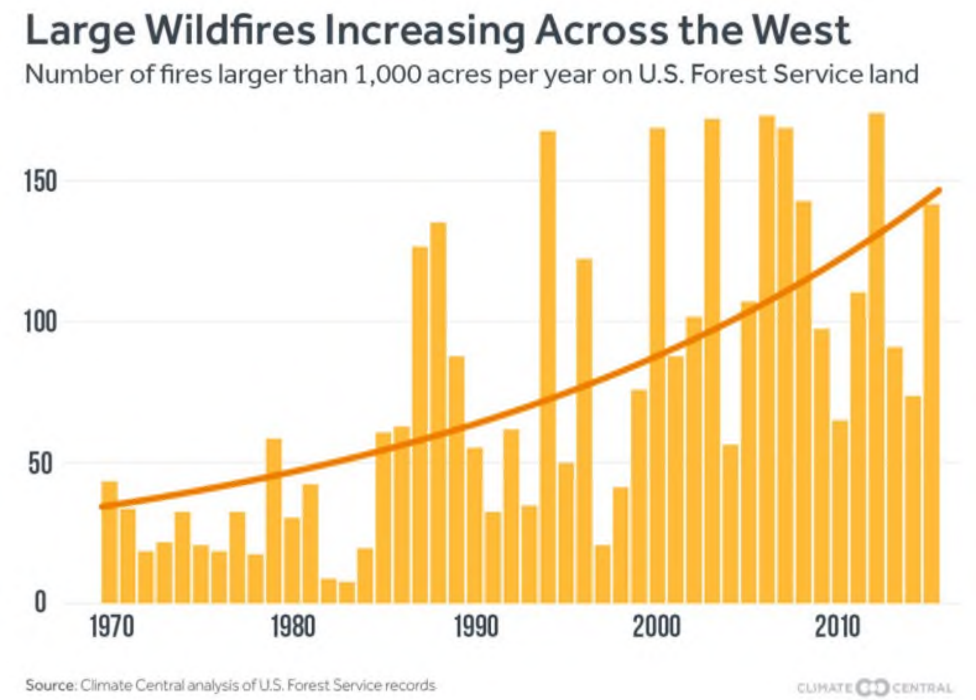
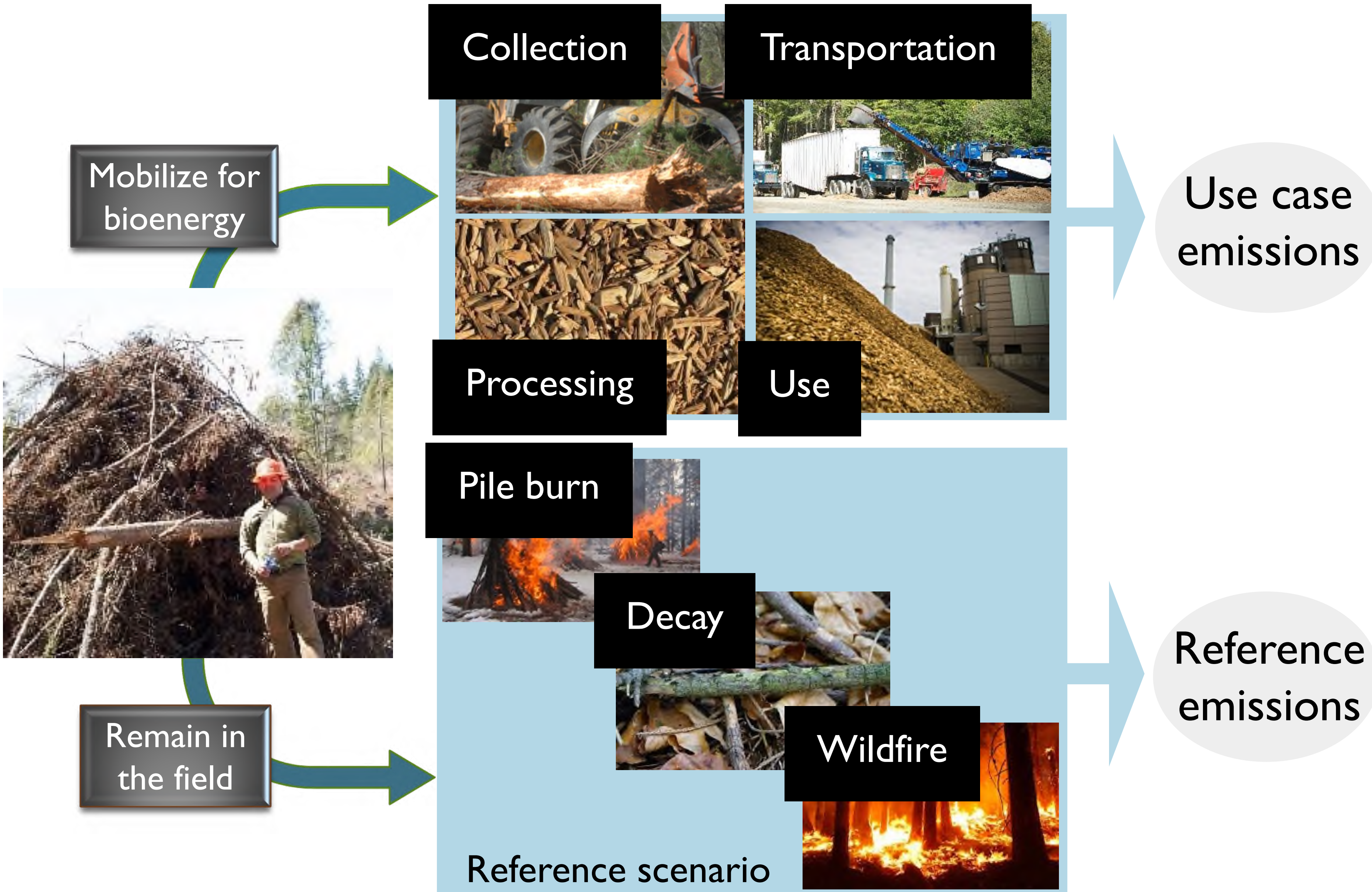
Background and Motivation

- California has a forest biomass problem
- Any solution of this problem should consider full impact
- California Biopower impacts Project addresses several considerations, including:
  - Total recoverable residue resource
  - Life Cycle emissions impacts
  - Wildfire effects of residue removal
  - Changes to soil emissions
- Significant spatial and supply-chain variability in the impacts of biomass energy
- Lack of transparency in Life-Cycle accounting
- The CBI Project aims to support policy makers and the private sector in shaping this industry



LCA Conceptual Structure



LCA Conceptual Structure

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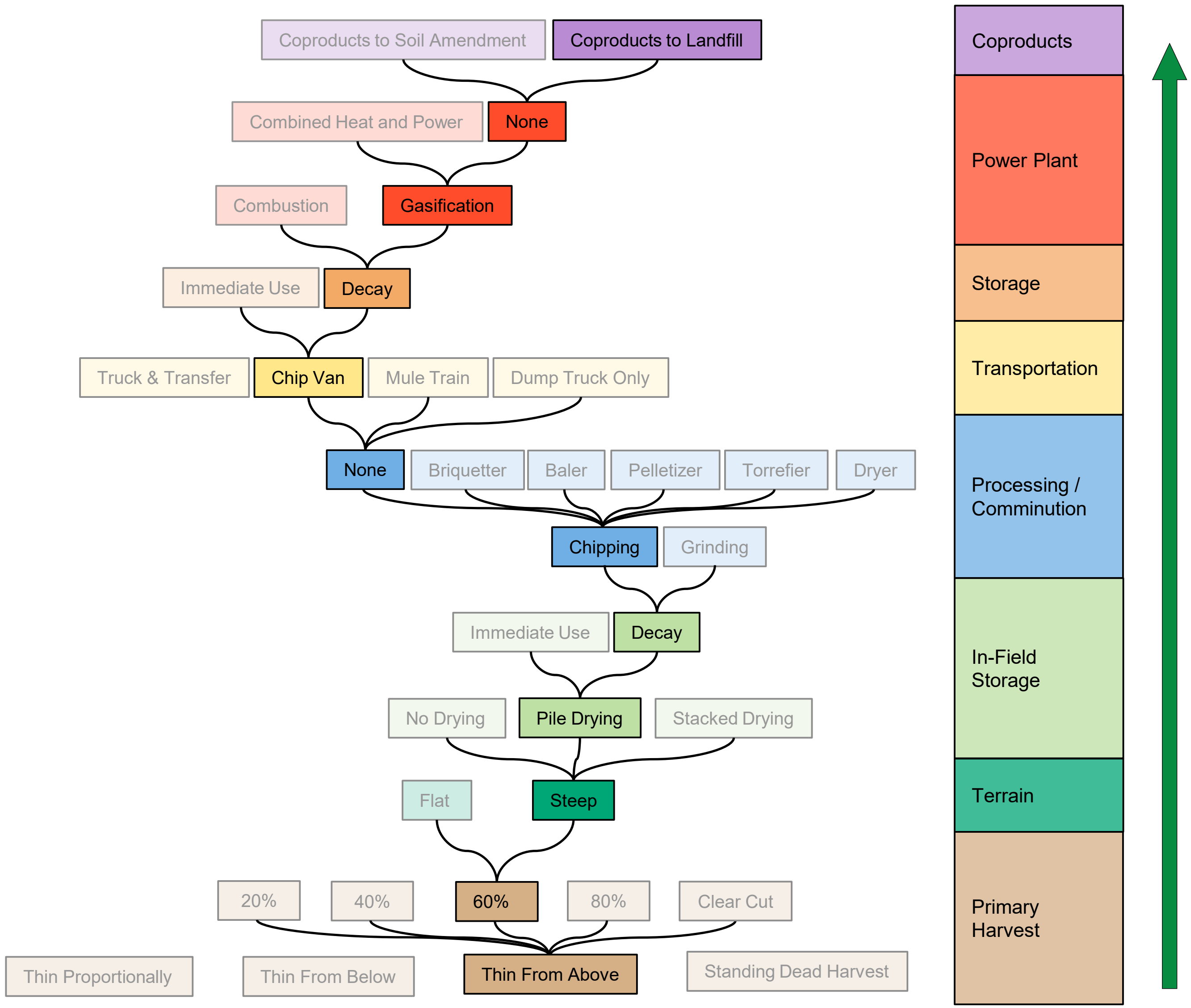
LCA Framework



LCA Conceptual Structure

Reference emissions

- Exponential decay – rate varying based on:
  - Composition: Material type and species
  - Disposition: Piled vs scattered material
  - Climate: Temperature and residue moisture level
- Wildfire emissions
  - Modeled using Consume model (USFS)
  - Applied to residue based on CALFIRE projections of fire probability
- Modeled out 100 years

Take-home messages

- Net emissions are variable and sensitive to a handful of characteristics.
- Identify what they are, and study them deeply.
- Target policy to mobilize the residues that offer most benefits
- May be net reduction in criteria pollutant emissions, but exposure is what matters
- Better tracking of pile burn emissions

Thank you!

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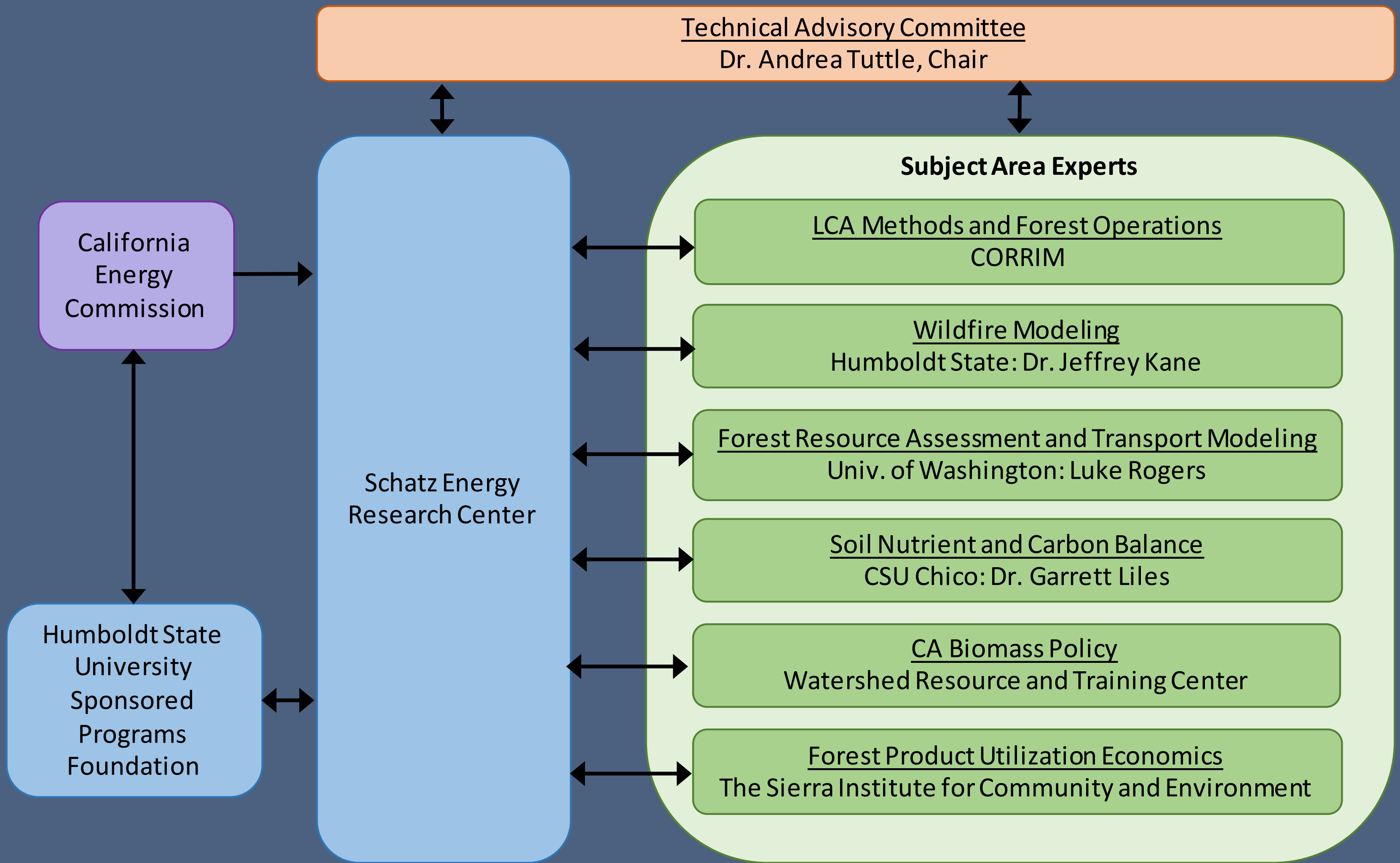
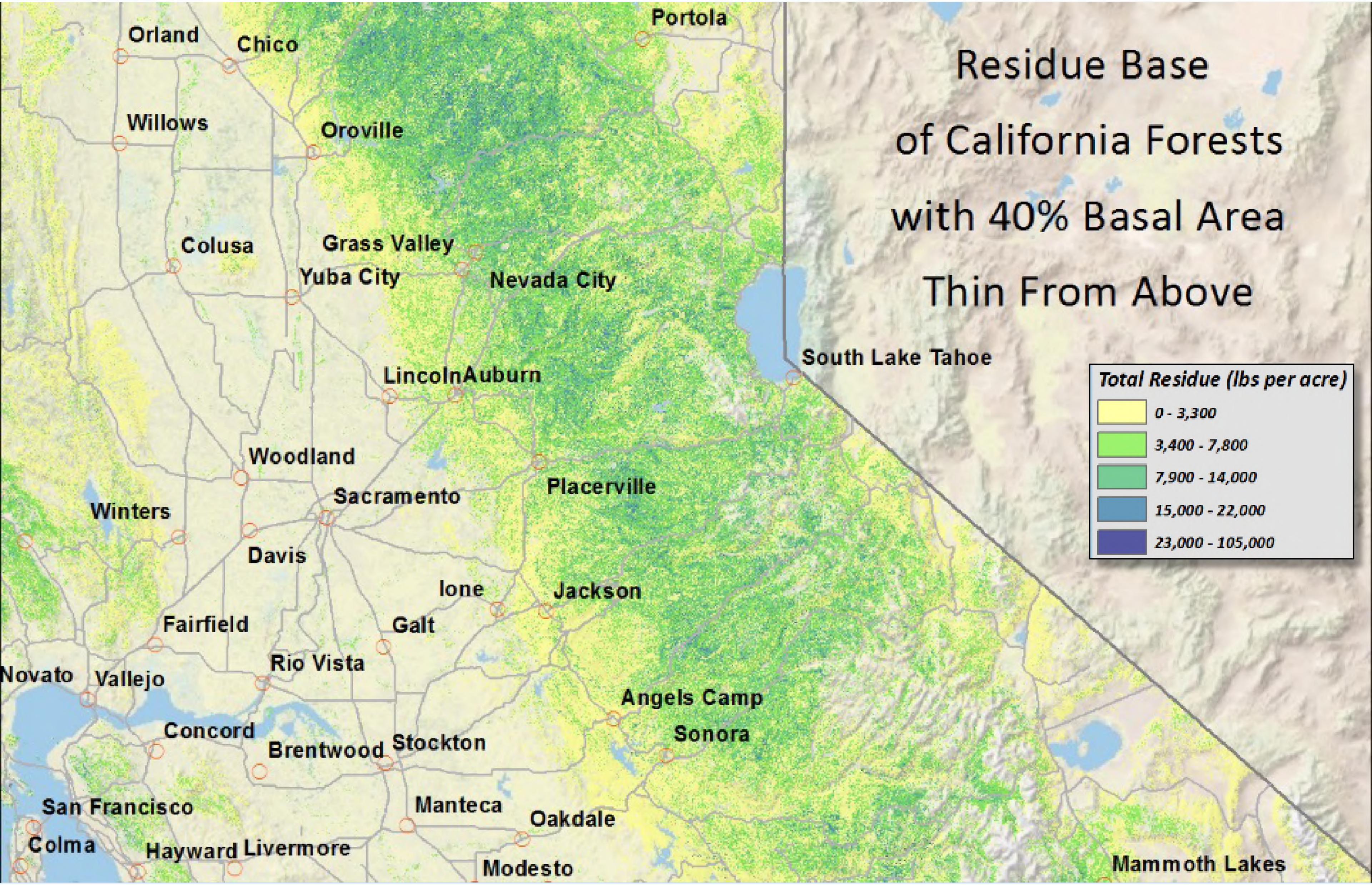
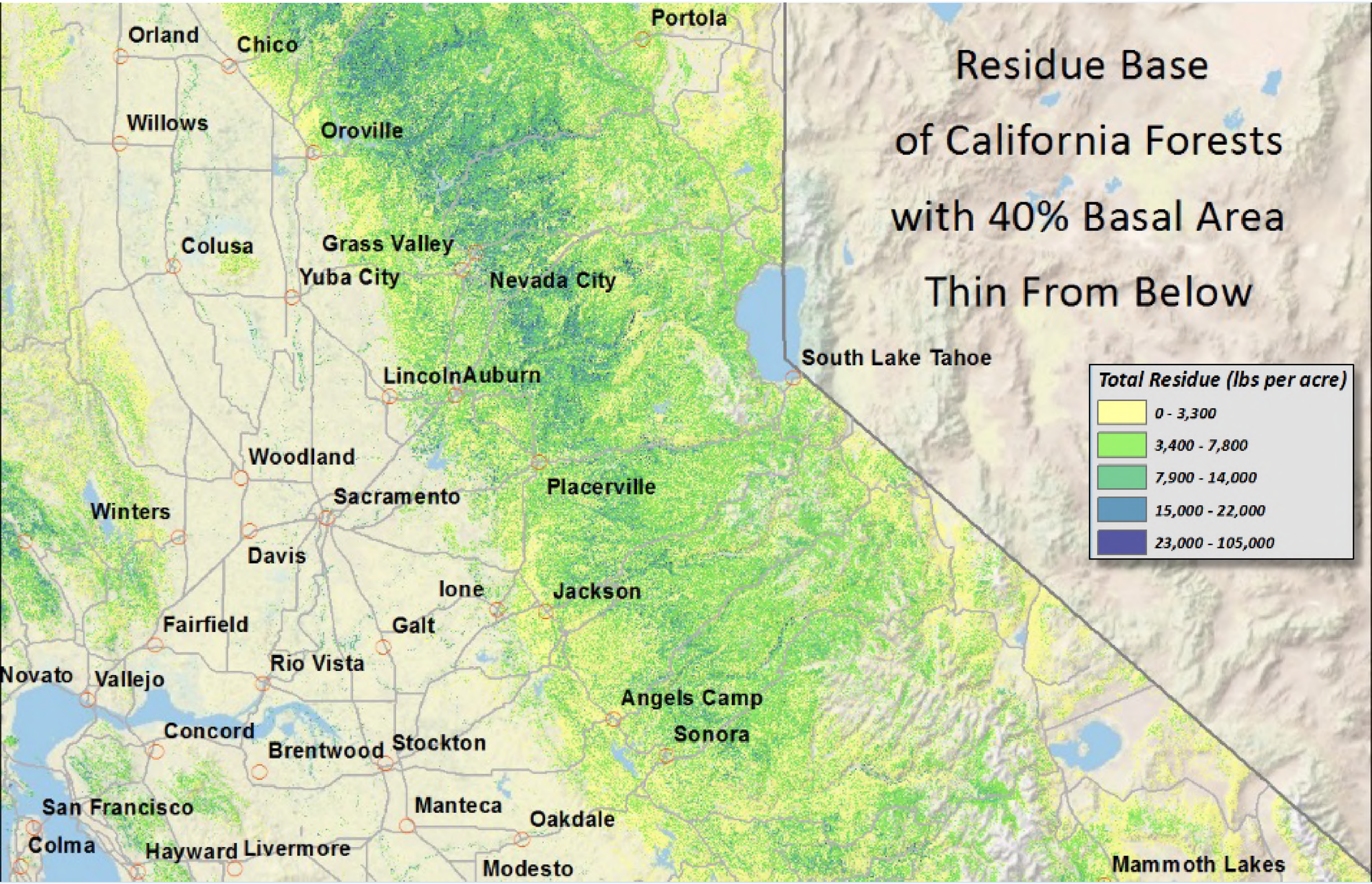


Residue Base of California Forests with 40% Basal Area Thin From Above



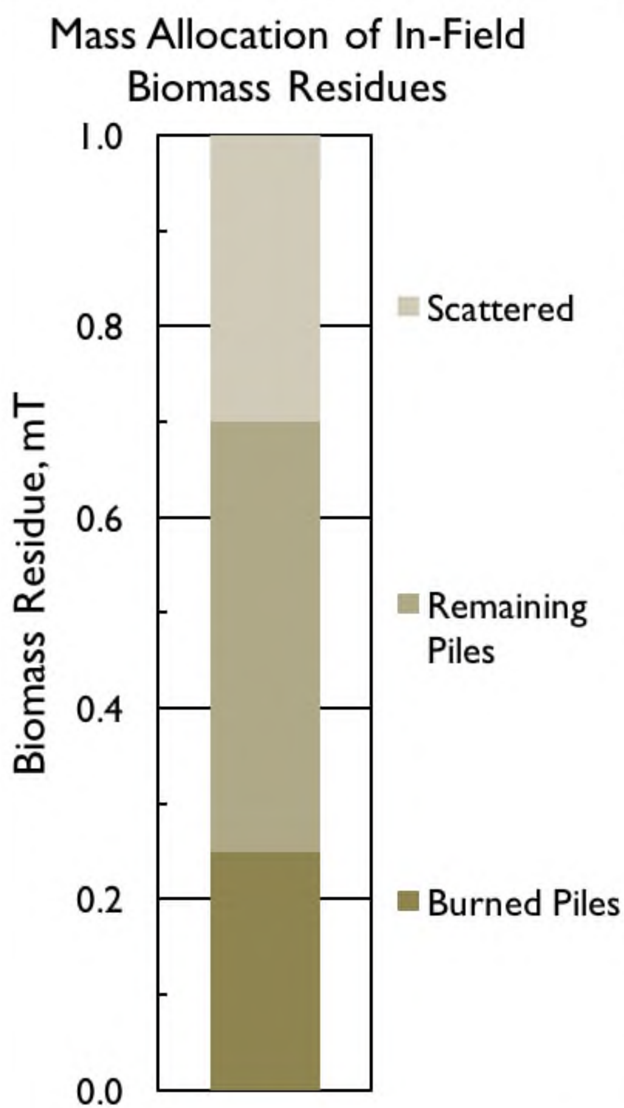
Residue Base of California Forests with 40% Basal Area Thin From Below



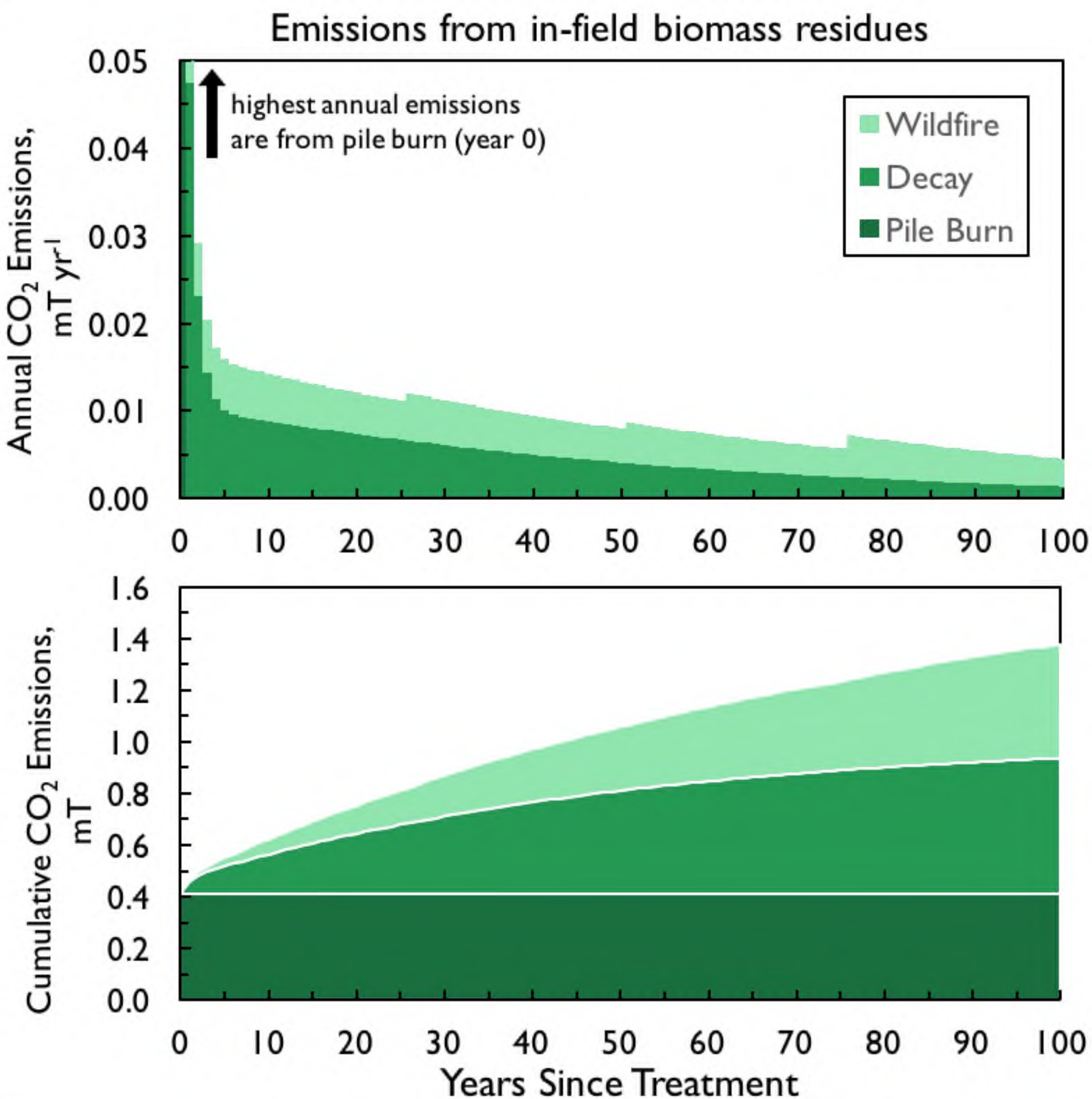
Total Residue (lbs per acre)
0 - 3,300
3,400 - 7,800
7,900 - 14,000
15,000 - 22,000
23,000 - 105,000

Model Capabilities/Sensitivities

- Location of source and destination in transport network
- "Counterfactual" fate of biomass
  - Burn probability, decomposition rate, etc.
- Wildfire frequency projection
- Supply chain characteristics such as harvest equipment, fuel use, landscape specifics, post-harvest treatment, and conversion technologies
- End-use technology pathway
- Analytical time horizon



*Soil efflux not shown



Key issues of scope

- We assume that the feedstocks are "true wastes" – they would not have otherwise been used
- As such, we don't allocate upstream emissions or sequestration to bioenergy supply chains
- Forestry and agricultural activity happens in both bioelectricity and reference cases, so land use emissions are not considered
- We don't consider the growth phase – only the reference fate for same material

Project Team

Technical Advisory Committee
Dr. Andrea Tuttle, Chair

California Energy Commission

Schatz Energy Research Center

Humboldt State University Sponsored Programs Foundation

Subject Area Experts

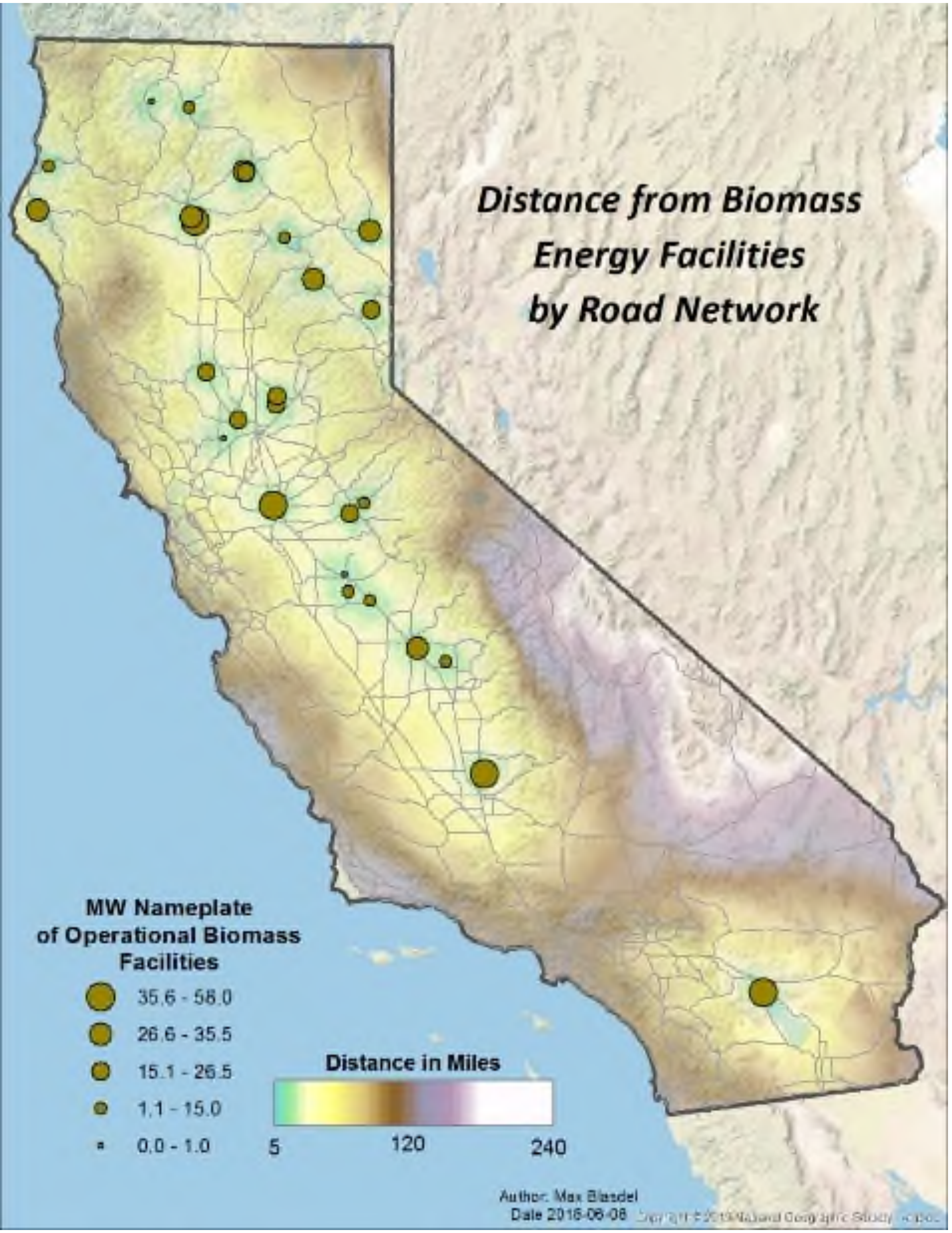
- LCA Methods and Forest Operations
  CORRIM
- Wildfire Modeling
  Humboldt State: Dr. Jeffrey Kane
- Forest Resource Assessment and Transport Modeling
  Univ. of Washington: Luke Rogers
- Soil Nutrient and Carbon Balance
  CSU Chico: Dr. Garrett Liles
- CA Biomass Policy
  Watershed Resource and Training Center
- Forest Product Utilization Economics
  The Sierra Institute for Community and Environment

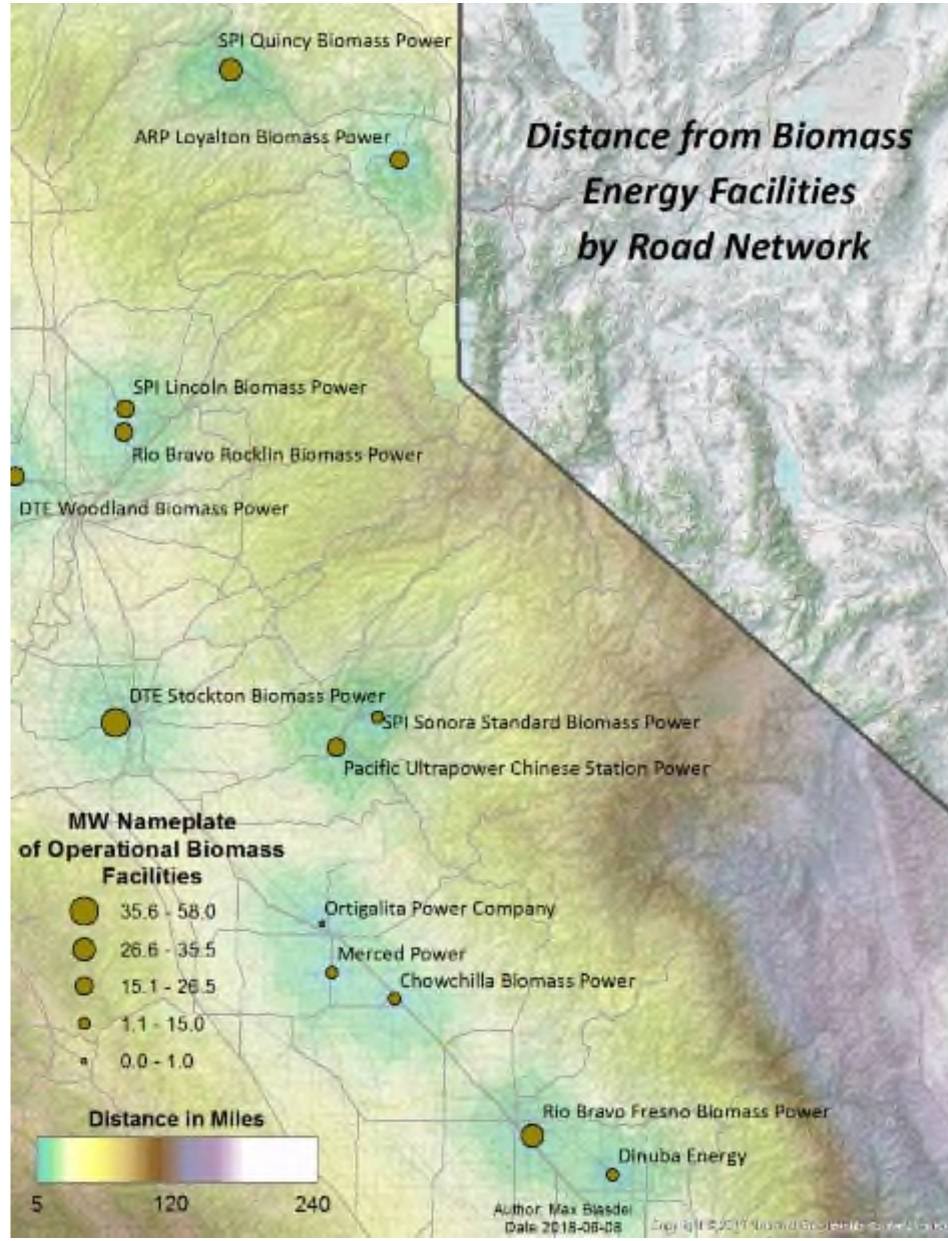
Technical Advisory Committee

- **Andrea Tuttle – chair – Pacific Forest Trust; US Endowment for Forestry**
- Annette Cowie – Government of New South Wales
- Alan Di Vittorio – Lawrence Berkeley National Laboratory
- Jacopo Giuntoli – International Council on Clean Transportation
- Amy Clark Eagle / Corey Brinkema – Forest Stewardship Council
- Neil Ewald – Green Diamond Resource Company
- Han-Sup Han – Northern Arizona University Ecological Restoration Inst.
- Garvin Heath – National Renewable Energy Laboratory
- Matt Hurteau – University of New Mexico Dept. of Biology
- Brian Kittler – Pinchot Institute for Conservation
- Matt Kruemenauer – Consortium for Advanced Wood-to-Energy Systems
- Angie Lottes – California Department of Forestry and Fire Management
- Tadashi Moody – California Department of Forestry and Fire Management

CutTPA	**Harvested trees per acre.**
CutBA	Harvested basal area (sq ft per acre).
CutQMD	Harvested quadratic mean diameter (inches).
CutCV6LT9	Harvested cubic foot volume per acre to a 6 inch top in trees with DBH less than 9 inches.
CutCV6GE9	Harvested cubic foot volume per acre to a 6 inch top in trees with DBH greater than or equal to 9 inches.
CutCV4To6	Harvested cubic foot volume per acre between 4 to 6 inches stem diameter.
CutBF6LT9	Harvested board foot volume to a 6 inch top in trees with DBH less than 9 inches.
CutBF6GE9	Harvested board foot volume to a 6 inch top in trees with DBH greater than or equal to 9 inches.
CutStem6BLT9	Harvested stem biomass (pounds per acre) to a 6 inch top in trees with a DBH less than 9 inches.
CutStem6BGE9	Harvested stem biomass (pounds per acre) to a 6 inch top in trees with a DBH greater than or equal to 9 inches.
CutStem4To6B	Harvested stem biomass (pounds per acre) between 4 to 6 inches stem diameter.
CutBarkStem6BLT9	Harvested bark biomass (pounds per acre) to a 6 inch top in trees with a DBH less than 9 inches.
CutBarkStem6BGE9	Harvested bark biomass (pounds per acre) to a 6 inch top in trees with a DBH greater than or equal to 9 inches.
CutBarkStem4To6B	Harvested bark biomass (pounds per acre) between 4 to 6 inches stem diameter.
CutBranchB	Harvested branch biomass (pounds per acre).
CutFoliageB	Harvested foliage biomass (pounds per acre).
CutStumpB	Harvested stump biomass (pounds per acre).
CutBarkStumpB	Harvested stump bark biomass (pounds per acre).

Transportation network





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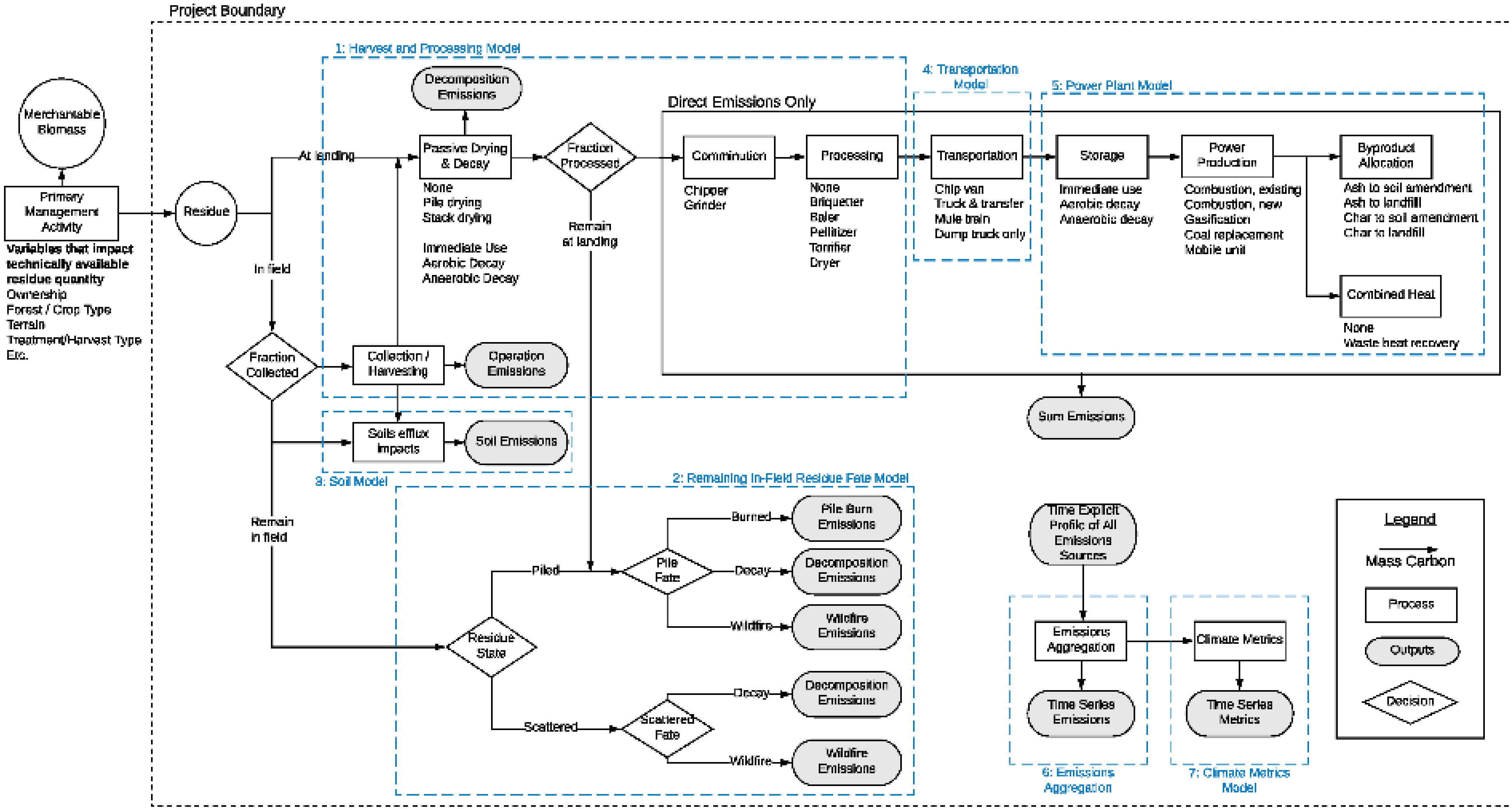
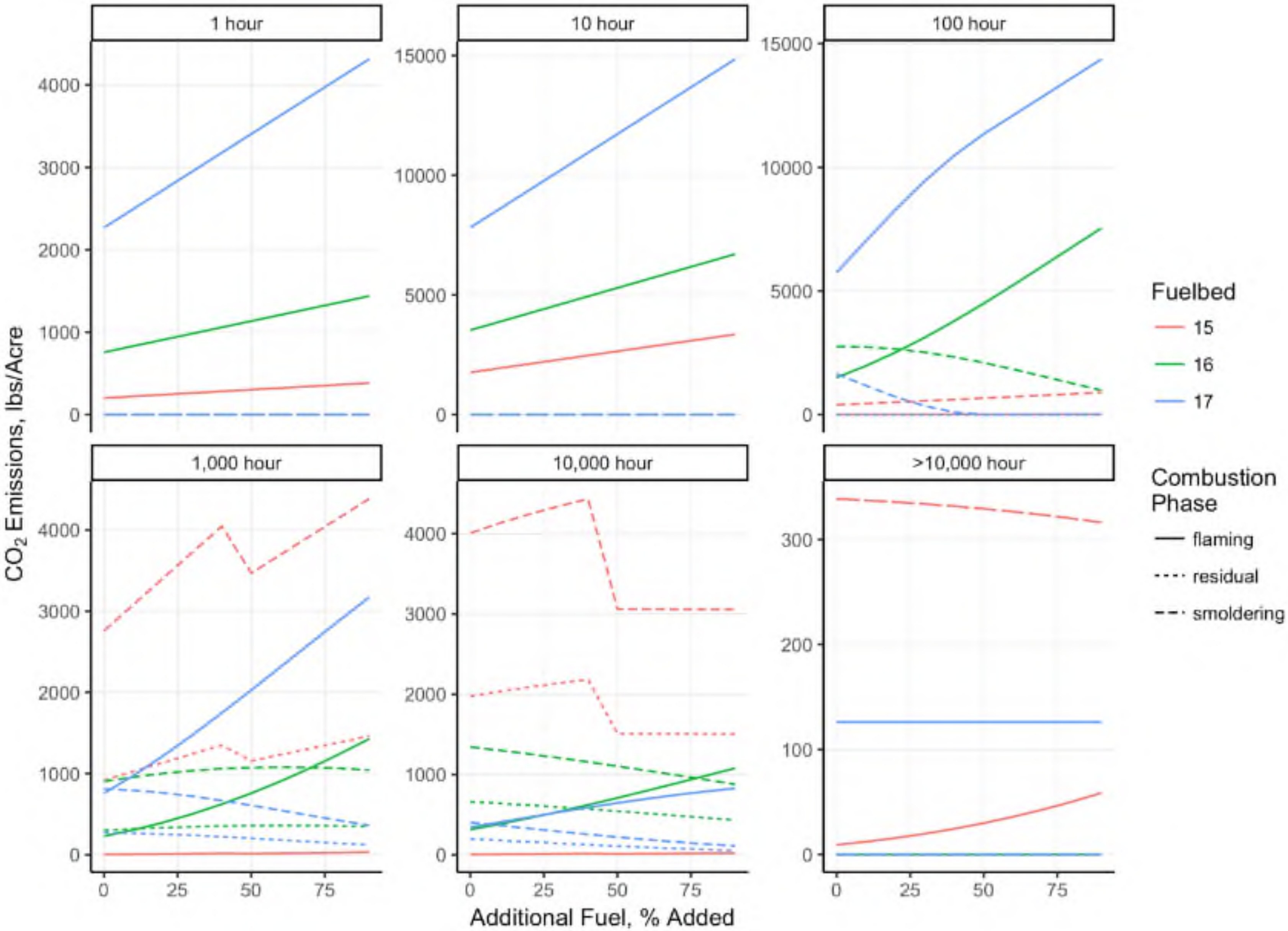
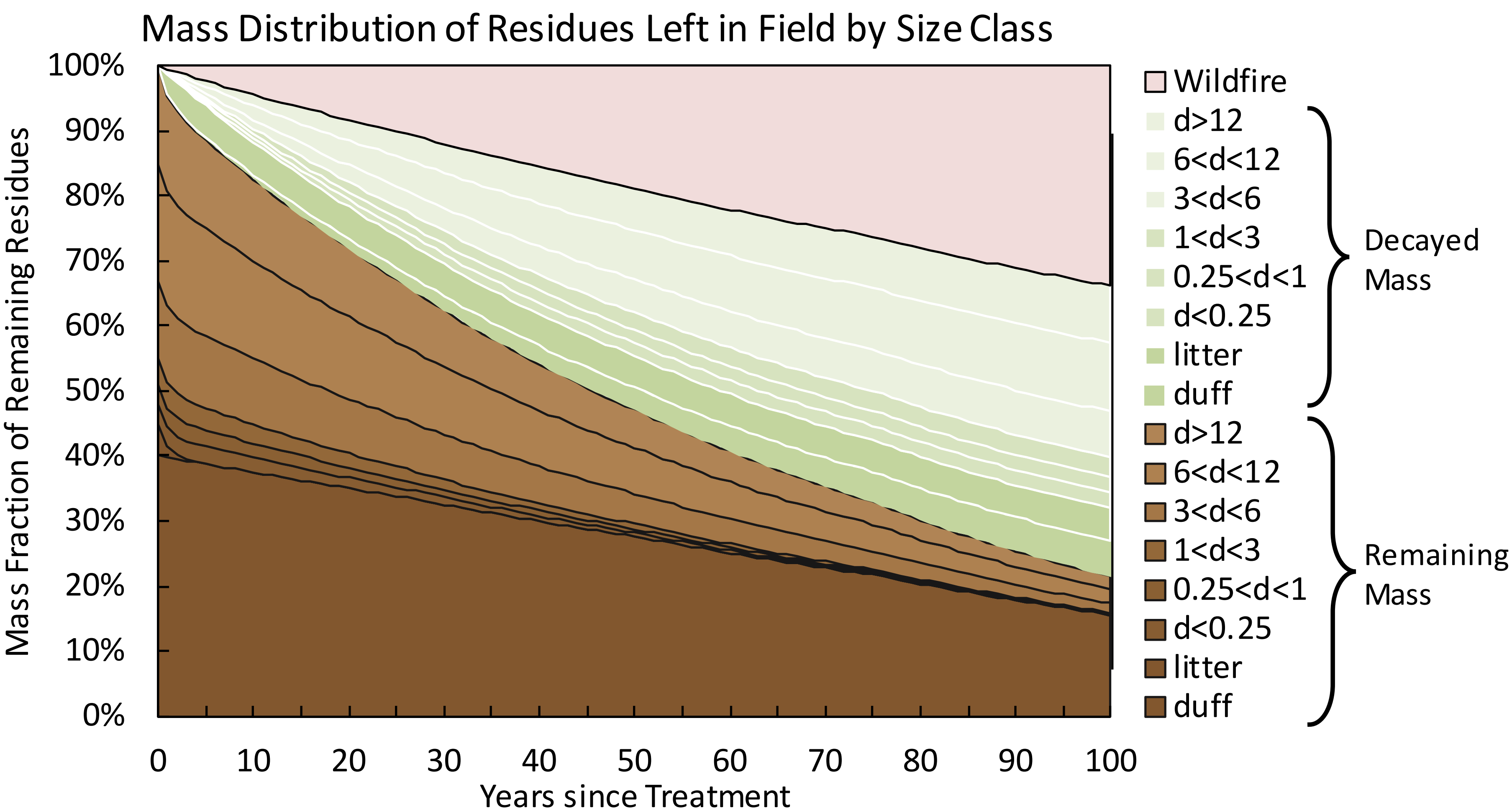


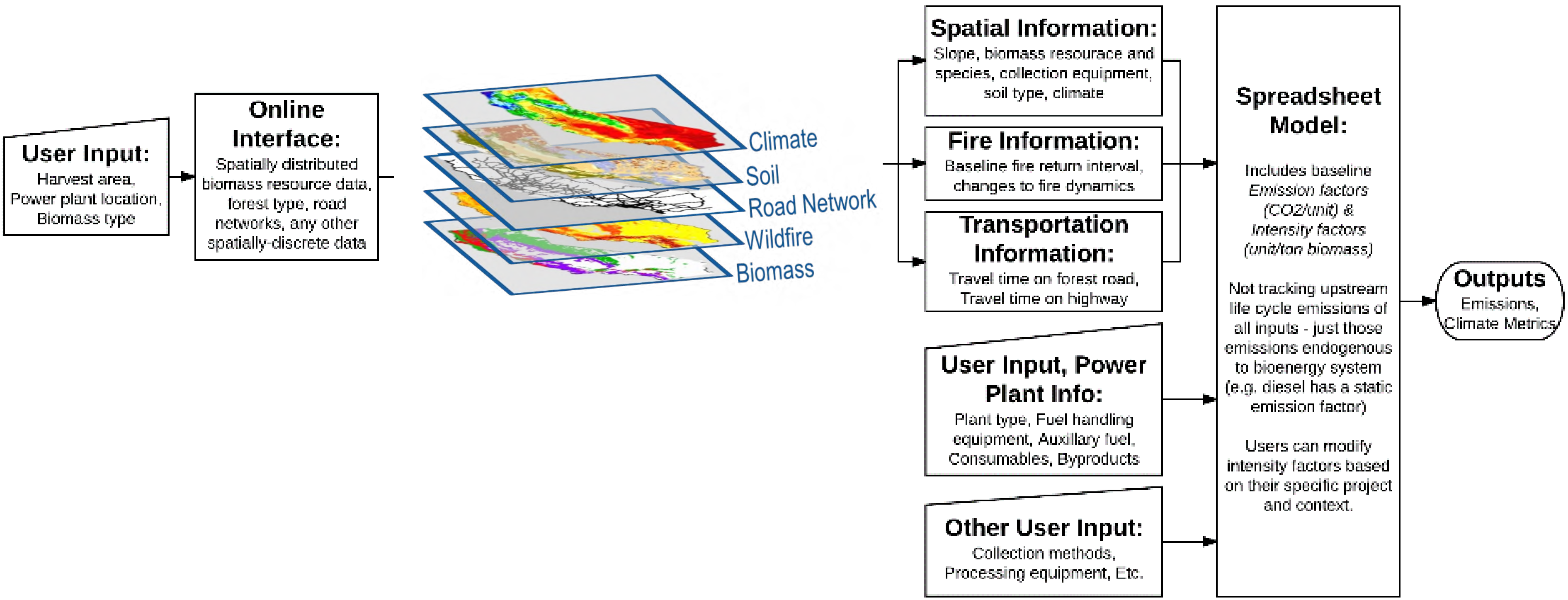
Task 3: Fire Risk Assessment



Task 4: LCA Framework



Spatial data in LCA



Example pathway

- User defines material type and harvest type
  - Woody biomass from harvest residue in forest type X
- This triggers 'utilization factors' for equipment **(Han)**
  - # operation minutes of equipment type a, b, and c per BDT of material at the landing
- Each of these 'utilization factors' has associated emission factors. **(CORRIM)**
  - x kg CO_2e per minute of operation of equipment type a, etc.
  - These are themselves life cycle characteristics, but we don't build them into the customizable model (except *maybe* device fuel efficiency and/or fuel CI)
- Transport distance and equipment 'utilization factors' **(UW)**
- These characteristics are defaults that can be user-customized as necessary.